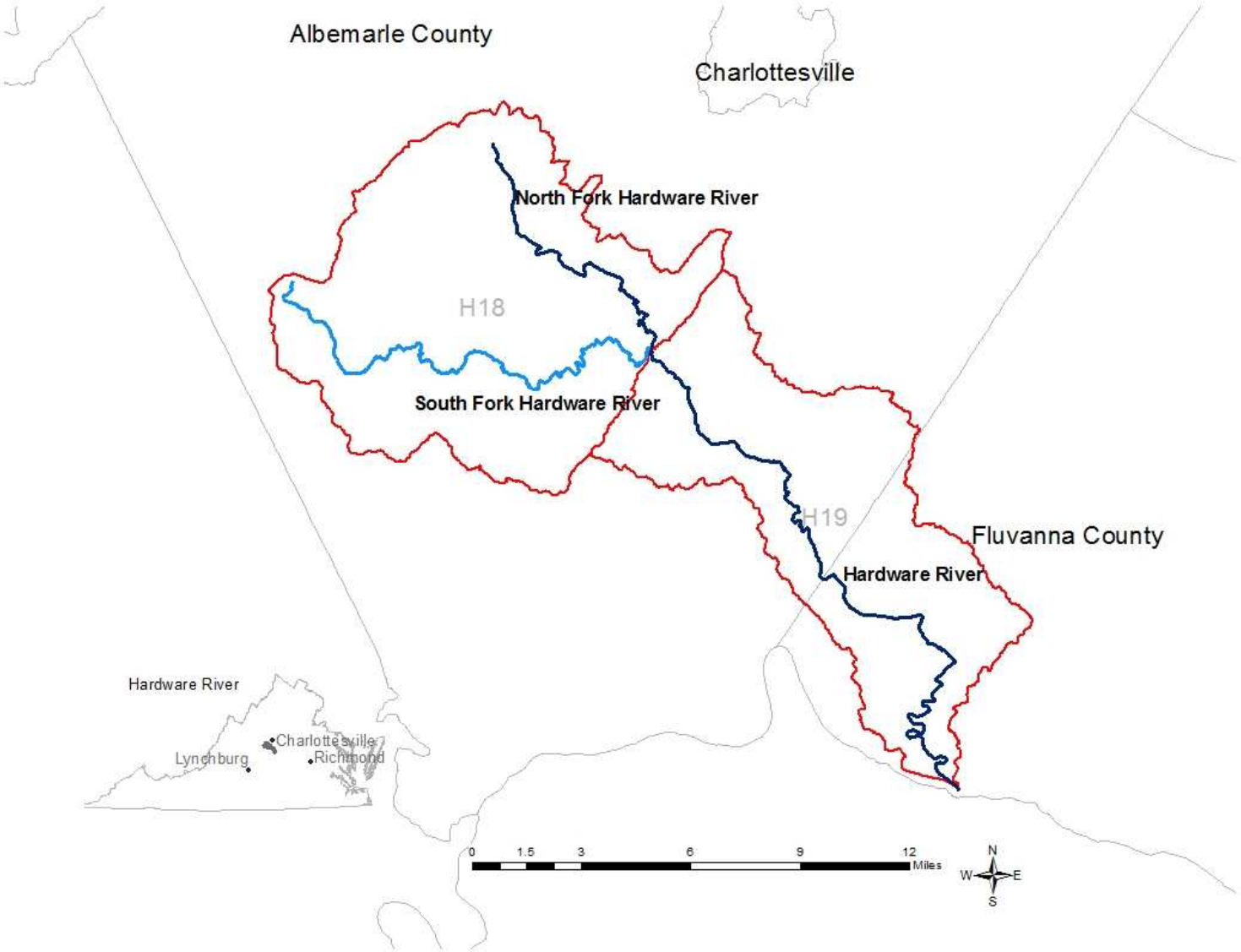
Hardware River and North Fork Hardware River Bacteria TMDLs - REVISED

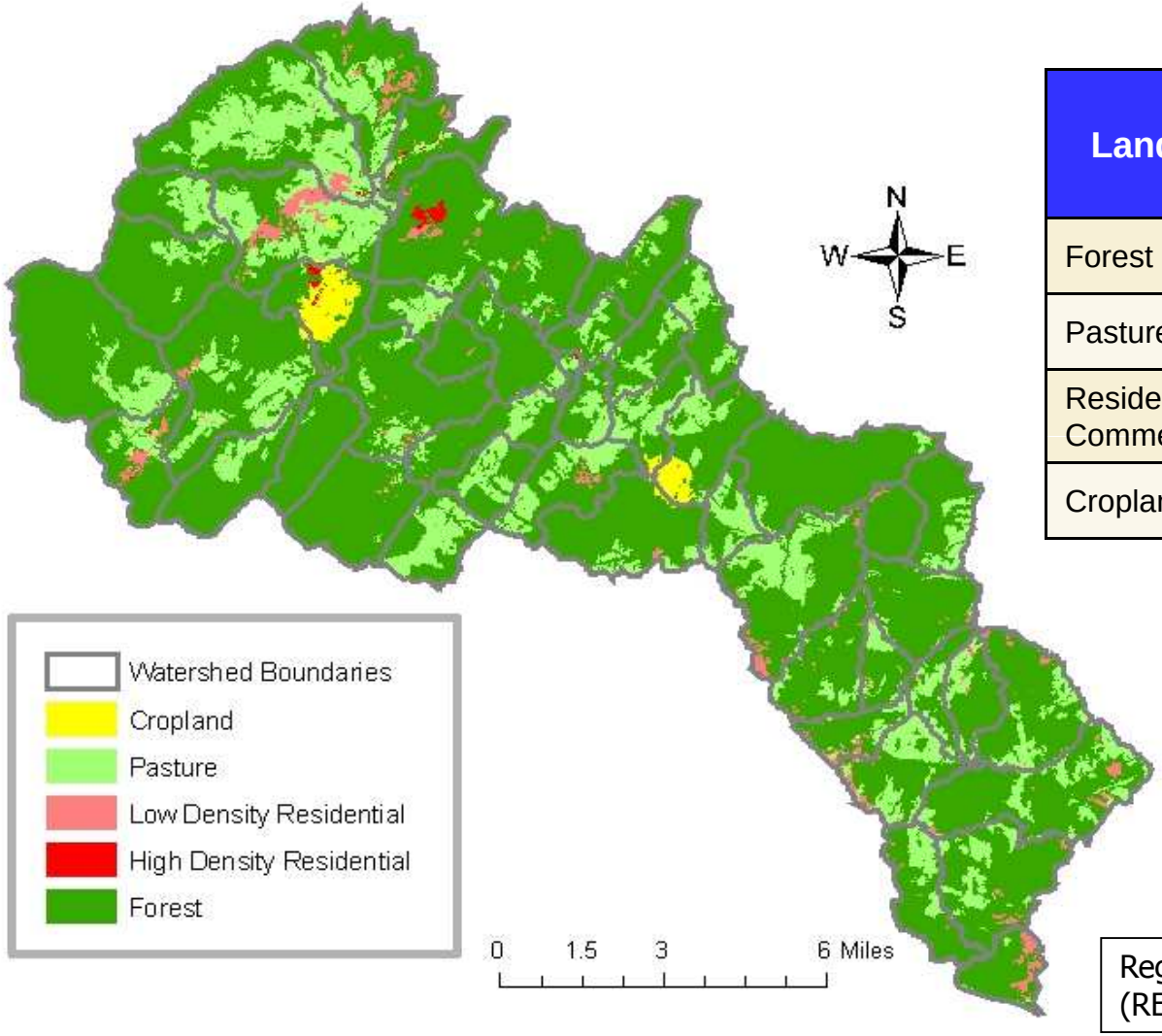
Final Public Meeting

September 2, 2015

Hardware River watershed



Land Use in the Hardware River watershed

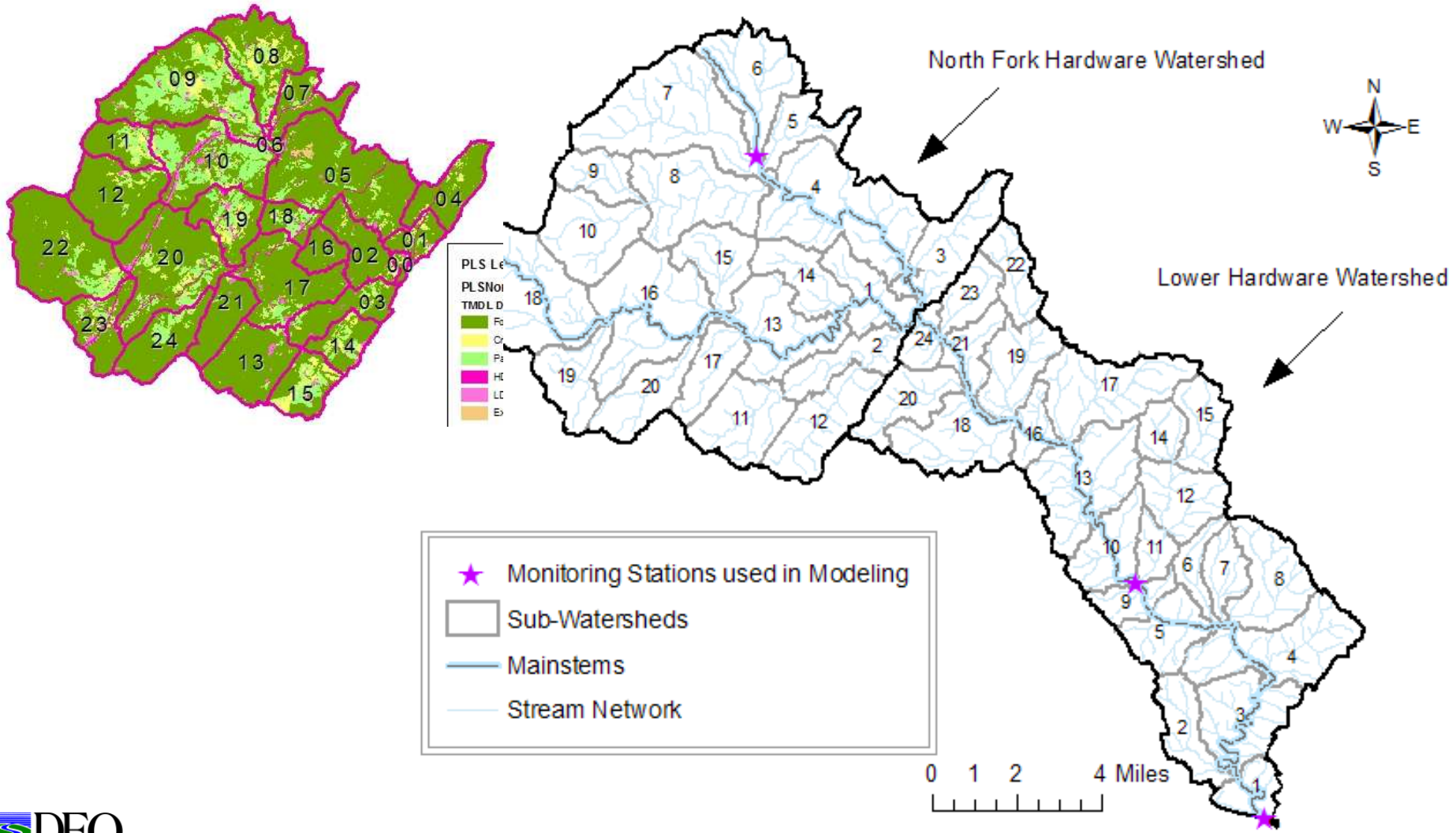


Land Use	North Fork Hardware	Hardware
Forest	69%	77%
Pasture	26%	19%
Residential and Commercial	4%	3%
Cropland	<1%	1%

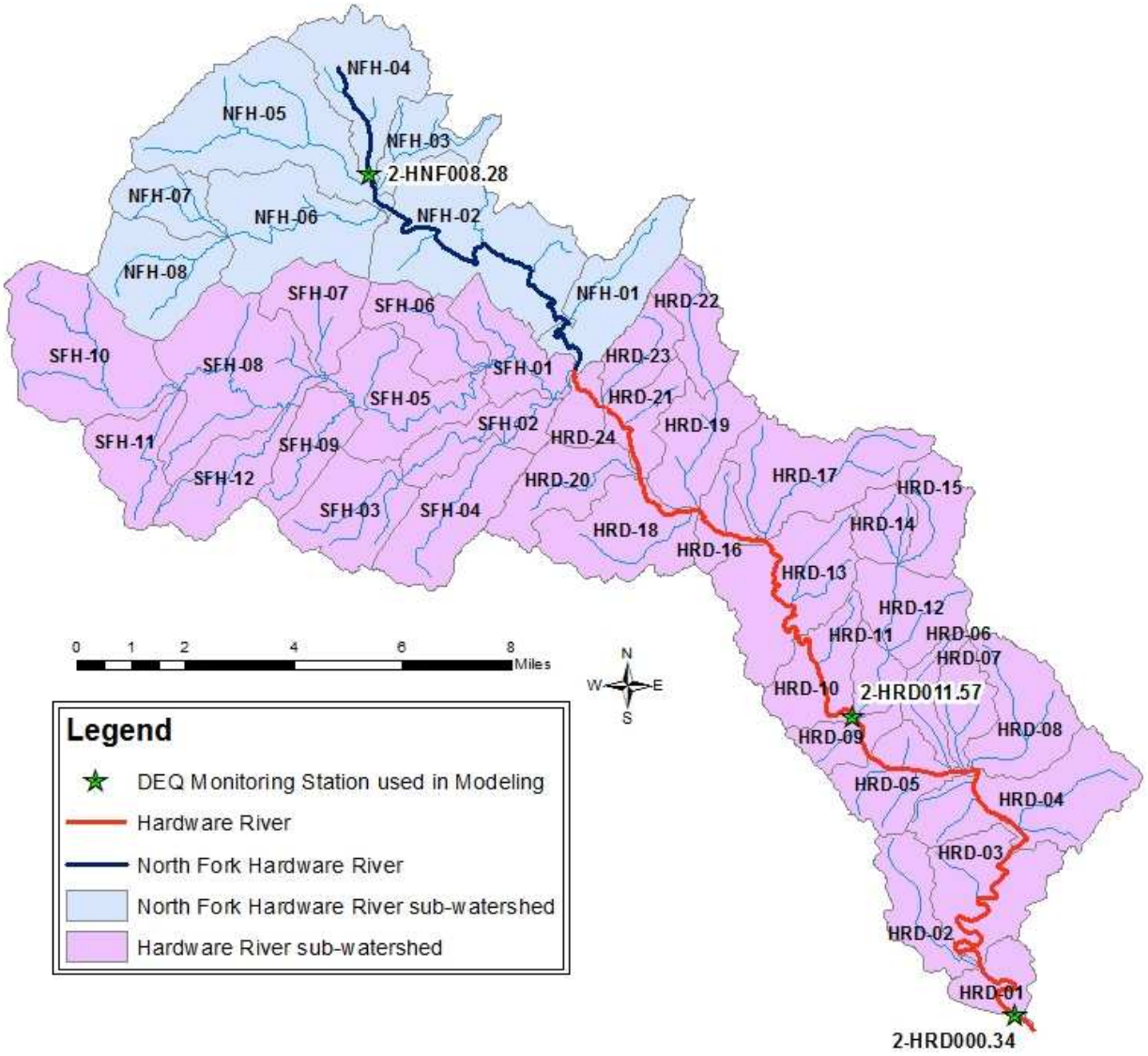
Regional Earth Science Application Center (RESAC) land use - 2000

Figure 2.1. Sub-watersheds for North Fork and Lower Hardware River watersheds.

(from original TMDL study, July 2007)



Sub-watersheds for North Fork Hardware River and Hardware River watersheds



VADEQ Monitoring Stations - Fecal Coliform Samples

Period of Record	Station ID	Station Description	Stream Name	No. Of Fecal Coliform Samples	Single Sample Maximum Criterion Violation Rate
1995 - 2006	2-HNF008.28	Rt. 708 Bridge	North Fork Hardware River	22	41%
1991 - 2006	2-HRD011.57	Rt. 637 Bridge at Gaging Station	Hardware River	134	21%
2004 - 2006	2-HRD000.36	Rt. 646 Bridge at State Wildlife Area	Hardware River	27	4%

VADEQ Monitoring Stations – *E. coli* Samples

Period of Record	Station ID	Station Description	Stream Name	No. of *E. coli* Samples	Single Sample Maximum Criterion Violation Rate
2005 - 2006	2-HAK010.23	Rt. 633 Bridge	South Fork Hardware River	7	14%
2005 - 2006	2-HAK001.34	Rt. 717 Bridge	South Fork Hardware River	7	0
2005 - 2006	2-HNS002.40	Rt. 712 Bridge	South Branch, NF Hardware R	7	57%
2005 - 2006	2-HNF008.28	Rt. 708 Bridge	North Fork Hardware River	9	78%
2005 - 2006	2-HNF005.03	Rt. 708 Bridge	North Fork Hardware River	7	29%
2005 - 2006	2-HNF000.10	Rt. 708 Bridge	North Fork Hardware River	7	0
2002 - 2006	2-HRD011.57	Rt. 637 Bridge at Gaging Station	Hardware River	31	19%
2003 - 2006	2-HRD000.36	Rt. 646 Bridge at State Wildlife Area	Hardware River	27	10%

Estimated fecal coliform loadings in the watersheds

Source	Fecal coliform loading ($x10^{12}$ cfu/yr)		Percent of total loading	
	North Fork Hardware River	Hardware River	North Fork Hardware River	Hardware River
Direct loading to streams				
Cattle in stream	(200) 18	(326) 83	(5%) 1%	(2%) <1%
Wildlife in stream	(35) 3	(107) 28	(1%) <1%	(1%) <1%
Straight pipes	4	(33) 16	<1%	<1%
Point Sources	<1	0	<1%	0
Loading to land surfaces				
Cropland	(0.06) 4	(17) 18	<1%	<1%
Pasture	(3,323) 3,170	(14,527) 18,212	(89%) 93%	(91%) 95%
Residential	(174) 182	(568) 656	5%	(4%) 3%
Forest	(16) 18	(471) 135	(<1%) 1%	(3%) 1%
Total	**(3,753) 3,400**	**(16,049) 19,148**		

Estimated relative contribution of *E. coli* by source at the stream outlet

Source	North Fork Hardware River	Hardware River
Nonpoint source loadings from pervious land segments	(72%) 82%	(13%) 81%
Direct nonpoint source loadings to the stream from wildlife	(6%) 4%	(18%) 4%
Direct nonpoint source loadings to the stream from livestock	(22%) 10%	(57%) 13%
Interflow and groundwater contribution	<1%	(6%) <1%
Straight-pipe discharges to stream	(<1%) 4%	(6%) 2%
Nonpoint source loadings from impervious land use	<1%	<1%
Point sources	<1%	<1%

Bacteria allocation scenarios for North Fork Hardware River

Scenario Number	Required Fecal Coliform Loading Reductions to Meet the *E. coli* Standards, %						% Violation of *E. coli* Standard	
	Live-stock DD*	Loads from Cropland	Loads from Pasture	Wildlife DD*	Straight Pipes	Loads from Residential	Geomean	Single Sample
Unsuccessful Scenarios								
Baseline Existing Conditions	0	0	0	0	0	0	50%	33%
1	100	100	100	0	100	100	0%	0.8%
Successful Scenario								
2	100	10	99	20	100	71	0%	0%
De-listing Scenario								
3	95	10	80	0	100	71	0%	9.9%

*DD = direct deposit to stream

Bacteria allocation scenarios for Hardware River

Scenario Number	Required Fecal Coliform Loading Reductions to Meet the *E. coli* Standards, %						% Violation of *E. coli* Standard	
	Live-stock DD*	Loads from Cropland	Loads from Pasture	Wildlife DD*	Straight Pipes	Loads from Residential	Geomean	Single Sample
Unsuccessful Scenarios								
Baseline Existing Conditions	0	0	0	0	0	0	36%	23.0%
Successful Scenario								
1	100	100	100	0	100	100	0%	0%
2	100	10	99	0	100	83	0%	0%
De-listing Scenario								
3	40	10	65	0	100	83	6%	10.1%

*DD = direct deposit to stream

Annual *E. coli* loadings (cfu/yr) for the TMDLs

Impaired Segment	Waste Load Allocation	Load Allocation	MOS*	TMDL
Hardware River	$0.04x10^{14}$	$3.64x10^{14}$	--	$3.68x10^{14}$
North Fork Hardware River	$0.03x10^{14}$	$3.48x10^{14}$	--	$3.51x10^{14}$

Impaired Segment	Waste Load Allocation	Load Allocation	MOS*	TMDL
Hardware River	$0.02x10^{13}$ *1% Future Growth* $0.024x10^{13}$	$2.38x10^{13}$	--	$2.40x10^{13}$
North Fork Hardware River	$0.06x10^{12}$ *VAG408054* $0.002x10^{12}$ *VA0083291* $0.035x10^{12}$ *1% Future Growth* $0.023x10^{12}$	$2.25x10^{12}$	--	$2.31x10^{12}$